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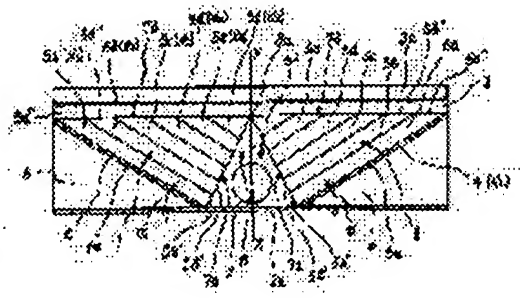
(54) OPTICAL WAVEGUIDE DEVICE FOR SURFACE ILLUMINATION

(57)Abstract:

PURPOSE: To uniformalize the brightness of the surfaces of a liquid crystal display panel, etc., with the optical waveguide device for illuminating these surfaces, to provide high brightness on this device and to miniaturize the device.



CONSTITUTION: Plural planar optical waveguide layers 5a, 5b, 5c... successively having refractive indices N1>N2>...>NK>>NL are laminated on a low-refractive index layer (NL) or highrefractive index layer 4 arranged to inverted V configuration. The light of the light source 2 within a cavity 8 for the light source is made incident from the respective light incident end faces 7a thereof and the light diffusion layer 3 of the refractive index NK>NL is brightened by the light emitted from the light emission end face 7b of the flat surface. Although the light propagating in the underlaid long planar optical waveguide layer 5a weakens, the light of the adjacent planar optical waveguide layer 5b is propagated by total reflection between the planar optical waveguide layer 5c laminated thereon and the low-refractive index layer or the high refractive index layer 4. This light is made incident on the planar optical waveguide layer 5a and interferes therewith to compensate the deficiency of the light quantity thereof. The brightness of the surface is thus uniformalized. Since there are no layers to cause a light loss in the optical paths, the high-brightness illumination is assured and since the light source 2 is internally provided at the center, the device is miniaturized.

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to amelioration of the photoconductive wave equipment for area lights is in various area-light equipments, such as a signboard, a display board, and a liquid crystal display back light, and makes brightness within the field homogeneity, and it enabled it to maintain at high brightness.
[0002]
[Description of the Prior Art] Since the demand of the area-light equipment with which high brightness is obtained is increasing and it corresponds to this in recent years by the spread of various displays, such as a word processor, a personal computer, a desk electric computer, a liquid crystal television, and an LCD watch, while making brightness within the field into homogeneity, the **** area-light equipment shown in drawing 6 and the display panel using this have already been proposed (JP,64-78283,A).
[0003] This has whenever [predetermined tilt-angle] to the light source c arranged to the optical incidence the optical transmission object A of formation with two or more transparence plates a by which the laminating was carried out, and this optical transmission object A side b, and the transparence plate a concerned, and possesses the light reflex object e which ****(ed) to the optical outgoing radiation the above-mentioned optical transmission object A side d. And it is area-light equipment which illuminated the field by liquid crystal panel g by reflecting the beam of light from the optical outgoing radiation side d with the light reflex object e, changing into the diffused light, and scattering this with the tabular light-scattering object f which carries out field contact with the optical transmission object A concerned.
[0004] Furthermore, the optical diffuser as shown in drawing 7 is also proposed (JP,60-87387,A). This is an optical diffuser with which it comes to prepare the optical incidence end face h and the optical outgoing radiation end face i in the optical transmission object B. By the aforementioned optical transmission object's B being constituted by two or more plates j which have the translucency by which the laminating was carried out, and making each inclined plane k of the plate j concerned continue, the aforementioned optical outgoing radiation end face i is formed in a plane, and it is constituted so that the beam of light l of the light source c may carry out incidence from here to the optical diffusion plate m.
[0005]
[Problem(s) to be Solved by the Invention] However, when based on the photoconductive wave equipment which is the above-mentioned conventional object for area-light equipment, there are the following troubles. Namely, if it is in the area-light equipment of drawing 6 which is the former The optical transmission object A is formed by making the small adhesives or the small air space of a refractive index intervene, and carrying out a laminating, in order to avoid the cross talk between the transparence plates a. The inside of each transparence plate a is spread independently by light by this, this light tends to be reflected with the light reflex object e as mentioned above, the diffused light tends to be acquired, and it is going to make it the field of homogeneity lighting by carrying out incidence of this to liquid crystal panel g with the light-scattering object f.
[0006] However, since the die length of each transparence plate a differs, respectively, naturally, a difference will arise also in each quantity of light reflected with the light reflex object e which that propagation loss was also different, therefore was prepared in the optical outgoing radiation the transparence plate a side d, consequently the unevenness of brightness will produce it in the center section and periphery of liquid crystal panel g. Moreover, although the light perpendicularly reflected among each light reflected with the light reflex object e, respectively by the g-th page of a liquid crystal panel (namely, when angle of reflection is about 45 degrees) passes through each transparence plate a, and said adhesives and air space with a small refractive index and reaches the g-th page of a liquid crystal panel The above-mentioned angle of reflection is very smaller than it, or in being large Since it is reflected or refracted by the

small adhesives or the small air space of the above-mentioned refractive index, it returns to the optical incidence the transparence plate a side b as a reflective return light and the g-th page of a liquid crystal panel is not reached, it also becomes bringing about the fall of the brightness.

[0007] Next, it is because the die length of the optical transmission object B by two or more plates j which carried out the laminating can come, and differs again, respectively, even if it is in the optical diffuser of above-shown drawing 7 which is the latter, so it becomes so dark that unevenness arises in each quantity of light of the optical outgoing radiation end face i, because it is so bright that the die length of the optical transmission object B is short and long. Namely, transmission loss changes with differences in the die length which each plate j of the optical transmission object B has. And it is difficult to carry out incidence of the light from the light source c to homogeneity into each plate j. And also in this case, since light spreads independently the inside of each plate j The light which cannot maintain the quantity of light from each inclination end face k at homogeneity, and has spread the inside of each plate j like the above Since it is propagation under the shut-up condition, by the case where it sees from the optical propagation direction side in the optical diffusion plate surface m, and the case where it sees from the reflection side, the difference of forward-scattering light and a back scattered light will be large, and the lighting unevenness depending on this cannot be avoided, either.

[0008] Then, although the laminating of the tabular lightguide as the transparence plate a and a plate j is carried out like said conventional technique in this application if it is in the photoconductive wave equipment for area lights of claim 1 per defect of equipment conventionally [above-mentioned] as a result of examination While it not only sets up phase reference suitable between each refractive index of these tabular lightguide, but this adds a low refractive-index layer with the suitable refractive index by which a laminating is carried out, or a high reflecting layer In the optical outgoing radiation end face of formation, by the above-mentioned tabular lightguide By carrying out the laminating of this and the optical diffusion layer of a refractive index selected appropriately, while equalizing the brightness within nothing and a field so that light may interfere also into other tabular lightguides, light not only passes through the inside of one tabular lightguide to each independence, but It is the 1st purpose that it is going to obtain the photoconductive wave equipment for area lights which can be illuminated in high brightness. Furthermore, in claim 1, while making right-and-left both sides have the above-mentioned configuration, it is the 2nd purpose that it is going to make it possible to obtain equalization and the high brightness of practical more effective brightness in a larger field, and to also make the whole magnitude small by arranging the light source in the dead air space for the light sources of a center section.

[0009] If it is in claim 2, it is in the photoconductive wave equipment for area lights of above-mentioned claim 1, and is making the rate of the minimum specific refraction between tabular lightguides into 1% or less further. Make a great portion of light in degree the mode spread in each one of tabular lightguides, and by this, illuminate an optical diffusion layer brightly and it is acquired. low -- And the propagation light of the higher mode interferes in the inside of other tabular lightguides, is spread, and tends to realize improvement in the uniform brightness within a field, and brightness thereby further.

[0010] It enables it to use the liquid crystal panel of the top face in an optical diffusion layer for the configuration of said claim 1 by carrying out arrangement addition at claim 3 at various displays, such as a liquid crystal display back light, a liquid crystal television, and an LCD watch.

[0011] It enables it to excite the light from the light source efficiently into a tabular lightguide at claim 4 by arranging a light reflex object on the light source bottom in the first half in addition to the configuration of claim 1 same as the above.

[0012] Even if it is going to increase the efficiency of the optical incidence from the light source and is in claim 6 by making this incline appropriately and forming it about the optical incidence end face of the optical transmission object formed in an above-mentioned claim thru/or above-mentioned claim 4 in the laminating of a tabular lightguide, at claim 5, it is going to raise the incidence effectiveness of light further by making this into a curved surface about an optical incidence end face as well as this.

[0013] In the case of claim 7, the low refractive-index layer or high reflection factor layer in this and claim 1 thru/or claim 4 even if it is in the case of the curved surface instead of a flat surface, it is shown that the effectiveness more than an EQC can be obtained, and by not coming out homogeneity thickness and considering as a tapering taper configuration, a tabular lightguide is going to strengthen interference of the light of said higher mode, and, thereby, promote equalization of the quantity of light within an optical diffusion layer further at claim 8. It enables it to carry out incidence of the light from the light source to homogeneity efficiently from an optical incidence end face furthermore by forming the tabular lightguide in the configuration of aforementioned claim 10 in the shape of [which was made crooked by the sideways layer and the inclined layer section] a hook in the case of claim 9.

[0014]

[Means for Solving the Problem] This application is a refractive index NL, respectively to each ** of right and left in claim 1 in order to attain the above-mentioned purpose. A low refractive-index layer or a high reflection factor layer is ****(ed), and it considers as arrangement of the shape of reverse Ha's character. To both the above-mentioned low refractive-index layer or an above-mentioned high reflection factor layer, it is all the above-mentioned refractive index NL. Are large. **** the tabular lightguide of necessary plurality which has NK (N1 >N2 > ... NK >>NL), and an optical transmission object is formed. the refractive index N1 used as a value small one by one, N2, and ..... Are in the optical transmission object concerned and the incidence layer end face which is the inside of each tabular lightguide in the right-and-left inside While making it continue from the inside low order edge in the low refractive-index layer or high reflection factor layer of said right and left, considering as an optical incidence end face, forming the dead air space for the light sources in the both light incidence edge face-to-face concerned and ****(ing) the light source here By making it continue so that it may become upward flat Men who connects the crowning in the aforementioned dead air space for the light sources from an outside high order edge [in / for the outgoing radiation layer end face which is the outside of the tabular lightguide concerned / a low refractive-index layer same as the above or a high reflection factor layer] Refractive index N1 which the tabular lightguide which forms said optical incidence end face and the optical outgoing radiation end face formed successively, and is stacked said bottom on this optical outgoing radiation end face has Big refractive index NH It is going to offer the photoconductive wave equipment for area lights characterized by forming the optical diffusion layer.

[0015] In claim 2, in addition to the configuration of above-mentioned claim 1, the above-mentioned tabular lightguide is selected so that it may become multi-mode optical transmission. Minimum relative index difference **1 =[(NK-N1) /NK] x100% in these tabular lightguides It is making to be set up into the contents so that it may become 1% or more, and similarly the case of claim 3 is in the configuration of claim 1, and the liquid crystal panel is arranged in the top face of the optical diffusion layer, And in claim 4, it adds to the configuration of claim 1 same as the above, and the light reflex object is arranged in the light source bottom in the aforementioned dead air space for the light sources.

[0016] In claim 5, the optical incidence end face of an optical transmission object is formed of the field where only the request include angle inclined towards the inside to the perpendicular of an optical outgoing radiation end face, In claim 6, the Uemitsu incidence end face of an optical transmission object is formed in a concave bend side to the light source, In claim 7, the front face of a low refractive-index layer or a high reflection factor layer is formed of the flat surface or the curved surface, In claim 8, the tabular lightguide of an optical transmission object is homogeneity thickness, or it has become contents incidental to claim 1 thru/or claim 4 to be formed so that it may be tapering off along the propagation direction of light at the shape of a taper.

[0017] In claim 9, it becomes each ** on either side from a horizontal level and the ramp of the successive formation to this. It is a refractive index NL, respectively. A low refractive-index layer or a high reflection factor layer is formed, and it considers as arrangement of the shape of a character of an ancyloid 8. both the above-mentioned low refractive-index layer or an above-mentioned high reflection factor layer -- each -- the above-mentioned refractive index NL the refractive index N1 used as a value large and small one by one, N2, and ..... by NK (N1 >N2 > ... NK >>NL) **** the tabular lightguide of necessary plurality of juxtaposition to the horizontal level of said low refractive-index layer or a high reflection factor layer, and a ramp which consists of a sideways layer and the inclined layer section, respectively, and an optical transmission object is formed. Are in the optical transmission object concerned and the incidence layer end face which is each sideways layer inside of the tabular lightguide in the right-and-left inside While making it form successively from the inside low order edge of the horizontal level in the low refractive-index layer or high reflection factor layer of said right and left, considering as an optical incidence end face, forming the dead air space for the light sources in the both light incidence edge face-to-face concerned and ****(ing) the light source here By making it continue so that it may become upward flat Men who connects the crowning in the aforementioned dead air space for the light sources from the outside high order edge of a ramp [in / for the outgoing radiation layer end face which is each inclined layer section outside of the tabular lightguide concerned / a low refractive-index layer same as the above or a high reflection factor layer] Refractive index N1 which the tabular lightguide which forms said optical incidence end face and the optical outgoing radiation end face formed successively, and is stacked said bottom on this optical outgoing radiation end face has Big refractive index NH Photoconductive wave equipment for area lights characterized by forming the optical diffusion layer.

[0018]

[Function] When based on the photoconductive wave equipment for area lights of claim 1 The light from the light source stacks under **, and comes out, and it is a certain refractive index N1. The 2nd tabular lightguide of the refractive index N2 (N2 <N1) which incidence is carried out to the 1st tabular lightguide from the incidence layer end face, and is the upper load of this, Although it spreads carrying out total reflection of between the low refractive-index

layers or high reflection factor layers which are the refractive index NL of an underlay (NL<<N1), incidence is carried out into an optical diffusion layer from that outgoing radiation layer end face and the incidence part concerned is made bright, this quantity of light will become comparatively weak from the die length of the 2nd tabular lightguide being the largest.

[0019] However, the light from the light source which carried out incidence from the incidence layer end face of the above-mentioned 2nd tabular lightguide Spread carrying out total reflection of between the 3rd tabular lightguides and above-shown low refractive-index layers which are the refractive index N3 of the upper load (N3 <N2), and it enters in an optical diffusion layer. Since it not only makes bright the incidence part to the optical diffusion layer corresponding to the outgoing radiation layer end face, but the light from the 2nd tabular lightguide will interfere in it to the 1st tabular lightguide by this, this will play the role of the quantity of light compensation in the 1st tabular lightguide.

[0020] the above -- the same -- carrying out -- refractive index N3 it is -- the light which carried out incidence to the 3rd tabular lightguide While spreading carrying out total reflection of between the 4th tabular lightguides of a refractive index N4 (N4 <N3), low refractive-index layers, etc. which are the upper load, entering in an optical diffusion layer and performing quantity of light compensation of the 1st and 2nd tabular lightguide The part concerned of the optical diffusion layer corresponding to the outgoing radiation layer end face of the 3rd tabular lightguide is made bright, it does in this way, and an operation of contents same as the above is made to the tabular lightguide of the upper load one by one. And refractive index NK by which the laminating was carried out to the most significant Incidence of the most will be carried out to an optical diffusion layer, and the light which carried out incidence into the upper load tabular lightguide will make bright the part by the side of the most inner edge.

[0021] If it puts in another way, the light by which incidence was carried out into the tabular lightguide which carried out invagination to two or more layers will interfere each other mutually, and will spread, it will be canceled by this that the quantity of light by the lowest ********** lightguide is weak, moreover, the quantity of light from each tabular lightguide will be equalized by the aforementioned compensation, and the unevenness of brightness will be lost. Furthermore, having not said that there is nothing that will check this by the time light reaches an optical diffusion layer, and the reflected light arises towards the incidence side of light and the refractive index NH of an optical diffusion layer Refractive index N1 of the 1st tabular lightguide Since it is large, high brightness-ization of a field is realized.

[0022] Furthermore, since the above-mentioned optical transmission object is provided in bilateral symmetry and the light source is [a piece is also sufficient for things and] moreover inherent in the central dead air space for the light sources, the whole volume is also small, it ends and uniform brightness can be secured from the lateral part of the optical diffusion layer by which outgoing radiation will be carried out from the long tabular lightguide of a lower product covering the large field to a center section.

[0023] Next, when based on the photoconductive wave equipment for area lights of claim 2 Since light is transmitted in the inside of a tabular lightguide by multi-mode transmission and it was made for the minimum relative index difference to become more than **1 =[(NK-NL) /NK] x100%>=1% the inside of each tabular lightguide is spread, respectively -- low -- the light in degree the mode The most spreads each one of tabular lightguides independently, it contributes to this illuminating an optical diffusion layer brightly, and this is received. The propagation light of the higher mode Rather than the tabular lightguide of itself, it will interfere in other tabular lightguides with a high refractive index, they will be spread, this will more fully compensate the optical outgoing radiation quantity of light by the difference in the die length of each tabular lightguide, and the brightness within an optical diffusion layer side can be compared with homogeneity.

[0024] Since the liquid crystal panel was fixed on a part for the topmost part, area-light equipment with the field of the desirable homogeneity brightness by the liquid crystal panel concerned can be offered, incidence of the light from the light source is effectively carried out to a tabular lightguide, and it may make the brightness of a field, and the homogeneity of the quantity of light hold by claim 3 at claim 4 by having arranged the light reflex object on the dead-air-space bottom for the light sources.

[0025] The light from the light source is all efficient by making only a request include angle incline or making an optical incidence end face into a concave bend side in claim 5 and claim 6. It is incidence's being carried out to the optical incidence end face concerned, and making a tabular lightguide into the shape of a tapering taper, when a flat surface and the optical transmission effectiveness more than an EQC can be obtained with claim 7 even if a low refractive-index layer or a high reflection factor layer is a curved surface, and based on claim 8. Interference of the light of said higher mode can be strengthened and quantity of light equalization within an optical diffusion layer can be promoted more.

[0026] And in claim 9, the result can be made to perform incidence of the light to a tabular lightguide efficiently, and it

should be more satisfied with having considered as the configuration which a sideways layer is prepared in the incidence layer end-face side of the tabular lightguide in above-mentioned claim 1, and forms the inclined layer sections successively in the shape of crookedness to this of a result also about said interference of light is obtained.
[0027]
[Example] With the photoconductive wave equipment for area lights of a mold , left-hand side and right-hand side have bilateral symmetry structure centering on medial axis line X-X , and the so-called back light into which light be put be constitute from a center by the optical diffusion layer 3 of horizontal installation covering the right and left overall length to which invagination of various kinds of display panels by the optical transmission object 1 of a right and left pair , the light source 2 in a center section , liquid crystal panel 3a , etc. be carry out as show in drawing 1 . The above-mentioned optical transmission object 1 is the refractive index NL formed of the flat surface or the curved surface like illustration. It consists of a low refractive-index layer or a high reflection factor layer 4, and tabular lightguides 5a, 5b, 5c, 5d, 5e, and 5f of necessary plurality ****(ed) by the front face, and an above-mentioned low refractive-index layer or the above-mentioned high reflection factor layer 4 is formed in the front face in the base 6 of right-and-left both sides here.
[0028] Here, in this invention, it is arranged in the shape of [of reverse Ha] a character by an aforementioned low refractive-index layer or the aforementioned high reflection factor layer 4 being ****(ed) by right-and-left each **, and an aforementioned low refractive-index layer or the aforementioned high reflection factor layer 4 is formed in inclined plane 6a which is the front face of the aforementioned base 6 in the example of illustration. As a low refractive-index layer here Plastics, such as Teflon and polyvinylidene fluoride, SiO2 Or SiO2 Ti, germanium, P, B, F, aluminum, Ta, The thing containing at least one sort of additives for refractive-index control, such as Zr, Zn, Na, and K, glass, such as Pyrex, and MgF2, and ZnS-MgF2 A compound can be used. etc. -- An important thing is the refractive index NL concerned here. The above-mentioned tabular lightguides 5a and 5b, each refractive index (5c, 5d, 5e, and 5f) N1 which it has, N2, and ..... NK it compares, and is [low] fully low desirably, for example, is extent of 1.42-1.47 -- desirable -- as the thickness -- several zero commas -- more than micrometer -- if it is, it will come out enough.
[0029] The metal membrane by aluminum, Cr, Ag, etc. can be used for the above-mentioned high reflection factor layer. As the aforementioned base 6, a metal, plastics, wood, etc. are usable, and they are the tabular lightguides 5a and 5b..... In order to make the light from the light source 2 spread by low loss as 5f, transparent -- an ingredient with sufficient light transmittance -- it should select -- these refractive indexes N1, N2, and ..... NK ******** -- it is necessary to satisfy the following relation
N1 >N2 >N3 >N4 >N5 >NK >>NL -- that is refractive index N1 which lowest ******** 1 tabular lightguide 5a directly laid in a low refractive-index layer or the high reflection factor layer 4 has most -- being large -- one by one -- the 2nd and 3rd tabular lightguides 5b and 5c and ..... turning -- the refractive index N2, N3, and ... small -- becoming -- going -- these tabular lightguides 5a and 5b ... all -- above -- NL It has a big refractive index.
[0030] here -- the above-mentioned tabular lightguides 5a and 5b -- as ..... For example, the thing which added the additive for refractive-index control to the polymethyl methacrylate (refractive index 1.49) and the polymethyl methacrylate (refractive indexes 1.50-1.55), Organic materials, such as polyurethane (refractive index 1.555) and a photoresist (refractive index 1.615), glass ingredients, such as Corning 7059 (refractive index 1.544) and slide glass (refractive index 1.512), TiO2, aluminum 2O3, SnO2, GeO2, and Sb 2O3 etc. -- an oxide ingredient etc. can be used. moreover, these tabular lightguides 5a and 5b ..... is natural -- although what is necessary is just to be more than two-layer, it is desirable that it is a multilayer, and since the thickness of the whole which carried out the laminating will serve as the range of several mm to dozens of mm by the application, the thickness of each tabular lightguide is also set to 0.1mm - about about tenmm.
[0031] above -- carrying out -- the tabular lightguides 5a and 5b ..... on both the optical transmission object 1 concerned by carrying out a laminating From the inside low order edge of inclined plane 6a in right and left of said low refractive-index layer or the high reflection factor layer 4 Optical incidence end-face 7a is formed in right and left by making ... continue. each tabular lightguides 5a and 5b -- incidence layer end-face 5a' of ..... which is the inside, and 5b' -- The light from the light source 2 which the dead air space 8 for the light sources was formed among the optical incidence end-face 7a concerned, and was arranged here Above-mentioned each incidence layer end-face 5a', 5b' ..... Incidence is carried out. Claim 4 is started, it is the light reflex object prepared in the light source 2 bottom, a reflecting plate and a reflecting mirror are used, and, thereby, 2in drawing a is each tabular lightguides 5a and 5b about the light from the light source 2..... It enables it to have excited efficiently inside.
[0032] As the above-mentioned light source 2, a cold cathode tube, a luminescence diode array, an electroluminescent element, a subMICHUA lamp, etc. can be used, for example, 6 or 5mm of tube diameters specifically marketed, about 28cm of tube lengths, and the cold cathode tube of input power 8W can be used, and, of course, not the one light source

'but two or more pieces can also be made to equip by the upper and lower sides and right-and-left arrangement like the example of illustration. moreover, use for light reflex object 2a a metallic material, the plastics material, the glass material, etc. which ****(ed) high reflection factor ingredients, such as aluminum, Ag, and Au, on the front face, or The above metallic material itself can also be used, and as this light reflex object 2a, it can arrange over the base 6 on either side from the dead-air-space 8 bottom for the light sources like drawing 1 , or it can also arrange so that only the dead-air-space 8 bottom for the light sources may be closed as drawing 2 thru/or drawing 5 .

[0033] furthermore, from the outside high order edge of inclined plane 6a in right and left of the above-mentioned low refractive-index layer or the high reflection factor layer 4 each tabular lightguides 5a and 5b -- outgoing radiation layer end-face 5a" of ..... which is an outside, and 5 -- by making it continue so that it may become upward flat Men who connects top 8a [in / for ... / the aforementioned dead air space 8 for the light sources] b " Said optical incidence end-face 7a and optical outgoing radiation end-face 7b formed successively in the shape of curving are formed, and the incidence end-face 7a concerned concerning claim 5 makes only the request include angle theta have inclined towards an outside in the example of drawing 1 to optical outgoing radiation end-face 7b. By doing in this way, efficiently the light from the light source 2 Tabular lightguide 5a, 5b ..... It comes to be able to carry out incidence inside, as for the theta concerned, it is desirable to set it as the range to 30 degrees, and it is forming optical incidence end-face 7a which starts claim 6 as further shown in drawing 3 and drawing 4 so that it may become a concave bend side to the light source 2. They are each tabular lightguides 5a and 5b at a well head about the light from the light source 2 much more..... It can be made to carry out incidence. In addition, it is good to coat optical incidence end-face 7a with the film for acid resisting here.

[0034] On optical outgoing radiation end-face 7b of formation to the flat side formed as mentioned above the above-shown light diffusion layer 3 -- ****(ing) -- this time -- that refractive index NH NH >N1 it becomes -- as -- namely, the inside of a tabular lightguide -- most -- a refractive index -- size -- N1 It is made to become a big refractive index. By this each -- outgoing radiation layer end-face 5a" and 5 -- the outgoing radiation light from ..... will carry out incidence entirely to the optical diffusion layer 3 b ".

[0035] The glass which makes the light of this and the light source 2 penetrate with sufficient permeability as this optical diffusion layer 3, Ingredients, such as plastics and a compound, can be used, for example, it is SiO2. Or SiO2 Ti, glass, such as a thing containing at least one sort of additives for refractive-index control, such as germanium, P, B, F, aluminum, Ta, Zr, Zn, Na, and K, 7059 by Corning, Inc. glass, and Pyrex glass, -- and plastics, such as Teflon, polyvinylidene fluoride, and polystyrene, -- further -- aluminum 2O3, Ta 2O5, MgF2, and ZnS-MgF2 etc. -- a compound can be used.

[0036] Furthermore, as an aperiodic structural change is given and periodic or the light which spreads the inside of the optical diffusion layer 3 reflects irregularly on the front face of this optical diffusion layer 3, that homogeneity is further raised to it about the brightness in the whole surface of the optical diffusion layer 3. You may make it attain high brightness-ization further by [this] being able to realize aperiodic structure periodic or by using a scientific etching technique, a surface roughness polish technique, etc., and including a fluorescence ingredient in the inside of this optical diffusion layer 3, or a front face. For example, what had field-like structures, such as a square, circular, and an ellipse form, as an optical diffusion layer 3 is used that what is necessary is just to use the optical diffusion layer which mixed the fluorescent paint (blue dyeing) which had luminescence maximum wave length in the range of 400-700mm wavelength.

[0037] Although lessons was taken from attaching light reflex object 2a to the configuration of claim 1 about claim 4 here and already being explained, if it is in claim 3, he is trying to arrange liquid crystal panel 3a in the top face of the above-mentioned light [like / designation] diffusion layer 3 at drawing 1 , and it can use for various displays, such as a liquid crystal television, like the above by this. It becomes possible for considering as 45 or less degrees to be [whenever / tilt-angle / of the inclined planes 6a and 6a in which the above-mentioned right and left were formed here] desirable as for alpha, and to be able to make thickness of the equipment concerned thin by making alpha small whenever [tilt-angle] in this way, and to attain big screen-ization.

[0038] Although incidence of the light from the light source 2 is carried out to optical incidence end-face 7a when based on the thing of claim 1 constituted as mentioned above An incident light from incidence layer end-face 5a' of tabular lightguide 5a It is a refractive index NL most. A low low refractive-index layer or the low high reflection factor layer 4, and refractive index N1 of tabular lightguide 5a Small refractive index N2 It spreads carrying out total reflection between tabular lightguide 5b which it had. This is the outgoing radiation layer end-face 5a" to N1. Big refractive index NH Incidence is carried out into the optical diffusion layer 3 which it had, and the part concerned is made bright. Therefore, if it is only the above-mentioned quantity of light, since lowest ********** lightguide 5a is the longest, the brightness of the optical diffusion layer 3 corresponding to the above-mentioned part will be weak.

[0039] However, the light which carried out incidence from the incidence layer end-face 5b' into tabular lightguide 5b of **** next if it was in this invention It is a refractive index N3 from the tabular lightguide 5b concerned. Will carry out total reflection of between big tabular lightguide 5c, the aforementioned low refractive-index layer, or the high reflection factor layers 4, and it will be spread. Therefore, since the light concerned spreads also in tabular lightguide 5a, the quantity of light according [the light by which outgoing radiation is carried out from outgoing radiation layer end-face 5a" of the tabular lightguide 5a concerned] to the total reflection concerned to the above-shown quantity of light will be added, and compensation of the quantity of light will be performed. And, of course, the correspondence part of the optical diffusion layer 3 also becomes bright by the light from outgoing radiation layer end-face 5b" of tabular lightguide 5b.

[0040] Thus, if will carry out total reflection also of the light by which incidence was carried out to the tabular lightguide of the sequential upper load as mentioned above, it will be spread also to the tabular lightguide stacked under from it, quantity of light compensation will be performed and it puts in another way If the light spread in each tabular lightguide is made to interfere mutually, and may be made spread and it is in tabular lightguide 5e of the maximum upper load, the great portion of light which carried out incidence to this will enter in an optical diffusion layer, and it will illuminate a corresponding point brightly. Furthermore, since the optical transmission object 1 is **** (ed) by right-and-left both sides, by the light which stacks under both right and left and carries out Iriki from near tabular optical waveguide, both the outsides part in the optical diffusion layer 3 in this case serves as sufficient brightness, and can cancel the defect of the conventional example further. Moreover, since incidence of the light which carried out outgoing radiation from the optical transmission object 1 will be carried out to the direct light diffusion layer 3, it does not have the factor of the brightness fall in the conventional example, and does not generate the unwilling reflected light to an incidence side, either.

[0041] Next, when it explains per case of claim 2, it is made for the optical transmission mode which is in the configuration of claim 1 and spreads the inside of tabular lightguide 5a, and 5b.....5f to serve as multi-mode transmission, and it is minimum relative index difference **1 in this case. It attaches and is made to satisfy **1 =[(NK-N1) /NK] x100%>=1% conditions. While the light from the light source 2 will be efficiently shut up in a tabular lightguide and spreading by this The light of the higher mode will spread many. The propagation light of these higher modes In addition to the tabular lightguide of itself, interfere in the inside of a tabular lightguide with a refractive index higher than this, and it is spread. This will fully compensate the optical outgoing radiation quantity of light based on the difference in the die length in each tabular lightguide, will maintain the homogeneity of the brightness within the field of the optical diffusion layer 3 which should be satisfied more, and, moreover, will contribute to high brightness.

[0042] This invention is not limited only to each above-mentioned example, and also about a base 6, the cross section does not need to be a triangle, and if the gestalt of the optical transmission object 1 can be held, it is also good [a base] for there to be nothing and to form a low refractive-index layer or a high reflection factor layer in the inferior surface of tongue of tabular lightguide 5a.

[0043] Although formation by the field where optical incidence end-face 7a concerning claim 5 inclined, and formation by the concave bend side of claim 6 were already explained The front face of the low refractive-index layer in claim 1 thru/or claim 4 or the high reflection factor layer 4 as well as this It was made for what is shown in claim 7 to be formed of a curved surface like drawing 4 . ..... is also curving to lower ****** and the bottom surface part of it is this. in the example of illustration, it carries out convex-curved [of the above-mentioned curved surface] towards the bottom -- having -- therefore, this -- learning -- the tabular lightguides 5a and 5b -- Each tabular lightguide 5a and 5b ..... Interference of the light of the higher mode which has spread inside can be strengthened, and the bottom of equalization of the quantity of light within the optical diffusion layer 3 and reduction of the unevenness of brightness can be planned.

[0044] Next, the contents concerning claim 8 are the tabular lightguides 5a and 5b, as shown in drawing 2 ..... Thickness It forms so that it may be tapering off along the propagation direction of light at the shape of a taper. It is the thing it was made to serve as Wi>Wo when thickness by the side of optical incidence end-face 7a in ..... was set to Wi and thickness by the side of optical outgoing radiation end-face 7b was set to Wo. if it puts in another way -- the tabular lightguides 5a and 5b -- By giving such structure, they are the tabular lightguides 5a and 5b..... Interference of the light of the higher mode which has spread inside can be strengthened, and the quantity of light homogeneity within the optical diffusion layer 3 can be promoted.

[0045] Furthermore, the thing of claim 9 is the thing and the tabular lightguides 5a and 5b of claim 1 as shown in drawing 5 ..... The gestalt is different as follows. namely, the tabular lightguides 5a and 5b by which each ** on either side serves as arrangement of the shape of ancyloid Ha's character, and was ****(ed) on this by an aforementioned low refractive-index layer or the aforementioned high reflection factor layer 4 being formed of horizontal level 4a and ramp

4b -- each of the juxtaposition to the above-mentioned horizontal level 4a and ramp 4b also about ..... it consists of sideways layer 5H and inclined layer section 5S.

[0046] Namely, tabular lightguides 5a and 5b ..... Incidence layer end-face 5a', 5b' ... The laminating of the side is partially carried out to abbreviation parallel with flat Men of optical outgoing radiation end-face 7b. Outgoing radiation layer end-face 5a", 5b" ..... It is constituted so that it may be made to incline upward towards a side. By this the include angle theta of the above [case / of drawing 1] -- small -- it can carry out -- the light from the light source 2 -- efficient -- each tabular lightguide 5a and 5b -- because light advances into ..... to inclined layer section 5S which could be made to carry out incidence and were crooked from sideways layer 5H He can also fully expect now the above-shown interferential action by total reflection, and is trying to attain equalization of the quantity of light within the optical diffusion layer 3, and reduction-ization of brightness unevenness.

[0047]

[Effect of the Invention] Since this invention is constituted as mentioned above, when being based on claim 1 The refractive index of a low refractive-index layer or a high reflection factor layer, two or more tabular lightguides, and an optical diffusion layer is selected appropriately. Since light not only spreads, but interference of light was made to perform each tabular lightguide mutually independently, the brightness within the field of a display panel can be maintained at homogeneity by quantity of light compensation of the quantity of light from a long tabular lightguide being carried out by the light from a contiguity tabular lightguide. Furthermore, by interference of the light by the above-mentioned total reflection, since incidence of the optical outgoing radiation from each tabular lightguide is carried out to an optical diffusion layer in the degree range of Yoshinari ****** since the problem of the angular dependence that the unevenness of brightness arises is also solved by the direction seen like before, and loam **** is not contained in an optical transmission object in optical loss unnecessary like the conventional example and the unnecessary reflected light to incidence one end moreover is not generated, either -- high -- brightness lighting can be guaranteed. And since it becomes possible to be able to equalize large Men's lighting efficiently and to maintain at high brightness, since the whole was constituted in bilateral symmetry and the light source was prepared in the central part, the whole can also be miniaturized.

[0048] When based on claim 2, by making the minimum relative index difference into 1% or more further A mutual-intervention operation of the light in claim 1 is promoted, and the compensation effect of the quantity of light can be raised. The liquid crystal television which can demonstrate the property of the photoconductive wave equipment for area lights in claim 1 concerned since the liquid crystal panel is ****(ed) by the configuration of claim 1 in claim 3, Products, such as an LCD watch, can be offered and the case of claim 4 can make said the effectiveness promote further by attaching a light reflex object to the thing of claim 1.

[0049] Next, claim 5 thru/or claim 8 start the optical incidence end face, the low refractive-index layer or high reflection factor layer, and tabular lightguide of an optical transmission object in claim 1 thru/or claim 4. While the dead air space for the light sources is formed because only a request include angle makes an optical incidence end face incline in claim 5 By incidence of the light being efficiently carried out to an optical incidence end face, and making an optical incidence end face same as the above into a concave bend side by claim 6 further By being able to aim at improvement in effectiveness same as the above further, being able to strengthen interference of the light of the higher mode by making the front face of a low refractive-index layer or a high reflection factor layer into a curved surface, when it is claim 7, and forming a tabular lightguide in tapering off in claim 8 Interference of the light of the higher mode can be strengthened more as well as this and the above.

[0050] By having formed tabular lightguides successively in the shape of crookedness by the sideways layer and the inclined layer section, the incidence effectiveness of light will be raised and satisfaction will be obtained also about the interferential action of light at the case of claim 9.

[Translation done.]